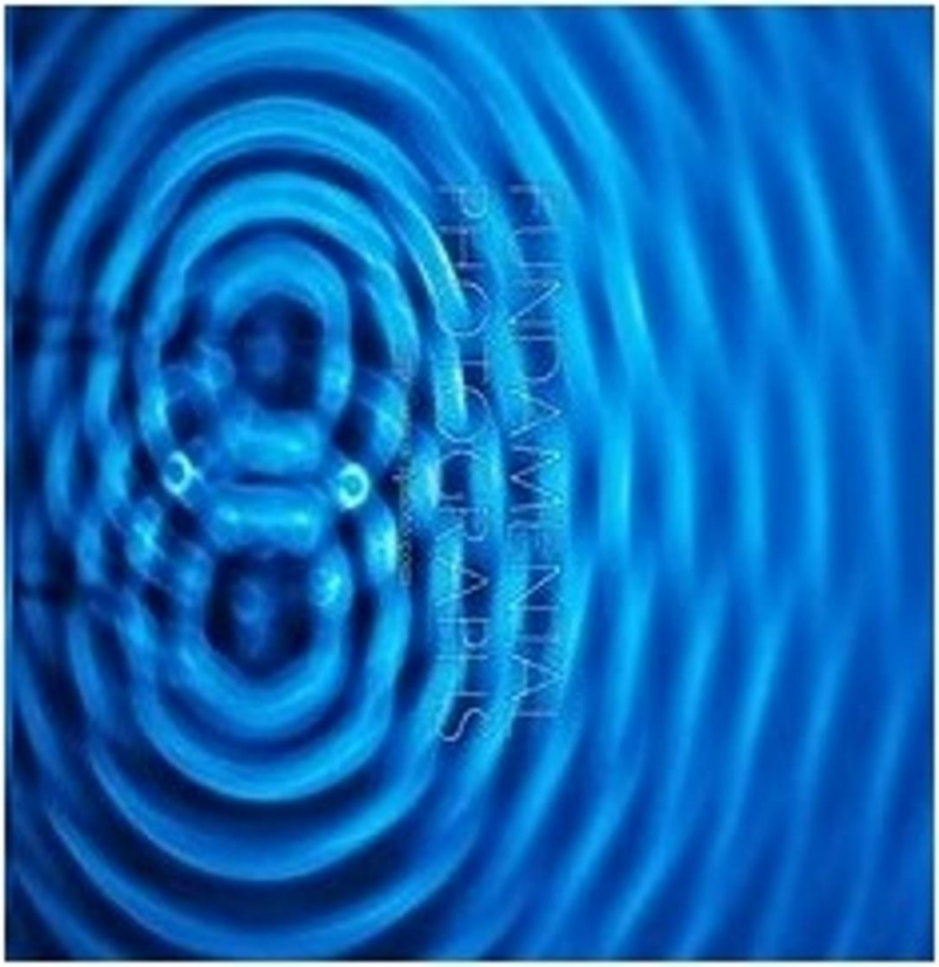
Quantum Magic 101

by Charlie Marino



FUNDAMENTAL PHOTOGRAPHS

$$\frac{d^2\Psi}{dx^2}+\frac{8\pi^2 m}{h^2}(E-V)\Psi=0$$

Quantum Magic 101

When viewing mathematical reality when it is beyond any current level of understanding, magic or gods are commonly invoked by humans. Clarke famously said, “Any sufficiently advanced science will appear as magic.”

When showing humans without fire how to create it, magic. When you mix saltpeter, sulfur, and coal together, and create an explosive, magic. When you fire a rifle to kill at a distance to people with spears and bows, magic. When such people see an airplane fly, magic. When you grow and refine mold on bread to destroy a life-killing infection, magic. All of it is science and the science of the 20th century was almost exclusively Newtonian, using what is referred to as “the scientific method”. Quantum Magic was first revealed then, but even the mathematical wizards who did the revealing – such as Plank and Heisenberg - found the results to be a disturbing departure from their concepts of reality.

When someone of lesser technology meets someone of greater technology, that is what happens. Quantum Mechanics is far more shocking. Not merely improvements that eventually the lesser beings could understand once they too had horses or started mining metals. Cause and effect no longer worked. Objects positive or negative could be a third thing. Information could time travel backward. This was true magic. If you are not frightened and awed by it, you clearly do not understand it.

I do not mean to disparage the scientific method. It gave us everything from the inclined plane, steam engines, electricity, and culminated in the electromagnetic equations of Maxwell and the special relativity of Einstein. That’s as far as it went, aside from improved engineering of those discoveries. Muggles are folk experienced in three-dimensional, sub-relativistic Newtonian existence. Immersed in their five senses. They have little ability or desire to understand the underlying quantum magic reality of the universe. Students of science, math, and the truth must embrace their unusual though limited abilities to pierce this veil. This paper is only a preface for the young in exploring the quantum realm.

Since it is a first taste, the mathematics is limited. In fact, many of the concepts herein may be understood by the aspiring student without yet achieving proficiency in related mathematics by which these results were derived. However, for those students who desire to become wizards themselves, it will not be possible without a fluid understanding of math and physics. These are your magic wands.

The first part details specific aspects of Muggle reality with which the student is expected to be fluent. You must have this knowledge at your fingertips. While boring or elementary feeling to some, it is a necessary step by which you shall differentiate yourself from the Muggles who cannot create and barely follow even such intuitive matters. They will never stretch their minds past this point in the required directions.

The second part of the paper is truly astonishing. It elucidates matters which have no counterpart in Muggle (Newtonian) reality. Such matters include multiple dimensions, dark matter & dark energy, the origin and expansion of the universe, and other exciting knowledge. Stretch your minds as I list the fundamental spells in the form of a few key equations and theories.

The third part of the paper briefly discusses how we got here. The people, the theories, the experimental proof of this magical realm.

The fourth part of the paper is specifically designed for those students who, unafraid of the depths to which parts 1 and 2 have taken them, wish to add to mankind's knowledge themselves. To do this, being fluid in Newtonian level mathematics & physics is not enough. Being fluid in calculus, general and special relativity, and Maxwell's equations are not enough. One must delve into the chaos and probability streams of the quantum realm itself. The parts of a fourth course contained herein are a mere introduction level to that wizardly world.

The student will be advised to remember that just as a baby first flails about in its crib not understanding how to move its arms and legs, nay, that it even has arms and legs, then must crawl before it can walk, then run, so too should those desiring to become wizards of the real (though hidden world) around us must not omit a single course of instruction. Learn the scientific method. Newtonian mechanics and machines. Learn thermodynamics, fluid mechanics, electromagnetism, and relativity. Learn operations research and the logic of programming languages. Master them, then tackle the wizarding world. No one, not even your instructors to come, knows what piece of esoteric but basic Muggle knowledge will be found false or limited and lead you to a new truth.

We've done more work with the quantum realm among the physically small (molecules, atoms, particles). While the theory is incomplete, it works well enough to engineer the transistor, the laser, computer motherboards, and nuclear power plants. Without quantum magic, we could not do any of these things. Even if engineers still don't know why most of it works. It just does.

At the physically large end of reality in galaxies and clusters of galaxies which we have limited ability to see, and no ability to experiment with, many quantum truths remain to be discovered.

One of the founders of quantum mechanics indicated, "Everything we regard as real, cannot be made of things which we regard as real." This is the very definition of magic. Or divine intervention; take your pick Muggles. Einstein famously said, "No reasonable definition of reality would be expected to permit quantum mechanics."

Welcome to Quantum Magic 101.

FIRST : Newtonian Simplicity

Chemistry of the water molecule, Cause and effect, Speed of light, Time is constant,

Straight lines are shortest distance between 2 points, Gravity exists, Mass and Length are constant,

A large particle is composed of small particles, Objects are connected by contact,

Momentum conservation, Opposite fields attract – similar repel,

A barrier of X energy height cannot be overcome by a particle of <X energy.

SECOND : Quantum Reality

The quantum water molecule, Cause and effect violated, Speed of light time violates addition, Light given off by a heated filament. Photoelectric effect, Radio waves: A light shining on a spark generator makes it jump easier, Light can affect electricity, Light was thought a wave, Time is not constant, Straight lines are not straight, There is no such thing as gravity, Mass is not constant, If a particle is small enough, it is not a particle but a wave Objects are connected by fields, not by contact Distances (lengths) are not constant, A barrier of X energy height can be overcome by a wave of <X energy.

Superposition, Physical duality, Nonlinear cause and effect, Hidden variables, Quantum Immortality, Future Big Bangs, Something from Nothing, Double Slit, Entanglement, Heisenberg, spectral lines the wave function, the Schrödinger equation.

THIRD : How We Got Here

The Ultraviolet Catastrophe

Light and the photoelectric effect

The Double-Slit Experiment

Bell's Theorem

FOURTH : Quantum Biology

Navigation Smell

Physical Metamorphosis

Photosynthesis Evolution

Consciousness

Behavioral Probabilities

Mind reading/ ESP

FIRST : Newtonian Reality

Chemistry of the water molecule

Three atoms, 2 hydrogen, 1 oxygen, are bonded in a bent shape at 104 degrees.

Electrons reside in regions outside the nucleus of an atom. (positive) The first region can hold 2, the next region 8, and up. Hydrogen has 1 electron so that region is incomplete. Oxygen has 8 electrons, 2 fill the inner region leaving 6 in the outer region, also incomplete. When two hydrogen combine with 1 oxygen, all three atoms share and have completed regions of electron occupation.

All of chemistry is defined by the behavior of electrons. Water has a covalent bond, which shares electrons. Molecules composed of atoms that completely donate & receive electrons are called ionic bonds.

The electrons in water are unequally shared, with oxygen having the greater attraction for them (electronegativity 3.5 vs 2.1 for hydrogen). Oxygen therefore appears to have a slight positive charge on the side away from those bonds, and the hydrogen a slight negative This polarity of the molecule allows water to weakly bond one to another. It makes water liquid at room temperatures (Standard Temp and Pressure = STP)

This polarity of the molecule gives water a surface tension, which is also critical for life. It is what allows you to fill a glass to slightly overflowing. It allows capillary action through a narrow tube key to allow water to travel up narrow organic channels against gravity in trees and plants.

The outer oxygen region of electrons is not smooth and random but concentrated into 4 lobes. The two already-filled lobes with 2 electrons each push away the attached hydrogen atoms, measured at a 104-degree angle.

Cause and effect: local causality

Time runs in one direction for any observer. A cause always precedes an effect for any object by any observer.

Speed of light

The speed of any electromagnetic phenomena, such as visible light, radio waves, x-rays, and gamma rays, is a constant 3E10 m/sec in a vacuum. Light will travel in a straight line unless reflected or refracted. It can travel slower in media such as water, which is what causes a straight beam to refract by a small angle at the media interface. Fishermen know to just look at a fish in a pond and know that the fish is in a slightly different position than you think just from looking.

Time is constant

Time runs at one speed. A second, minute, hour, day, or year is always the same duration for any object by any observer.

Straight lines are the shortest distance between 2 points

If you have a series of points of travel or in any geometric figure, the shortest distance between any of the points is a straight line. This is true in a single dimension - a line of dimension (x), two dimensions - a flat surface of (x,y), or three dimensions - a solid of (x,y,z). It is assumed to be true for higher dimensions as well. We cannot draw a four-dimensional object, but the shadow reduces by one dimension, as the shadow of a solid reduces to a flat 2-dimensional object.

Gravity is a property of mass

Two objects composed of any mass will be attracted to each other at a distance by the relationship:

$$F = G\frac{m_1 m_2}{d^2}$$

F = force
G = 0.00000000066.7
m = mass
d = distance

This force continues in the same manner to infinite distances decreasing by the inverse square of the distance between the objects. The gravitational field force does not appear to have an opposite repulsive force.

An object of a certain mass will be observed to always have the same mass, whether it is at rest or moving.

Mass and Distances (lengths) are constant

An object of a certain mass or length will be observed to always have the same mass and length, whether it is at rest or moving. Conservation of mass and energy are laws without exception.

A large particle is composed of small particles

All masses are composed of smaller masses. The smallest unit of mass to still retain the chemical properties of the original mass is called an atom. There are 92 naturally occurring atom types – called elements – in nature. These elements can be organized into a Periodic Table which relates families of elements to each other with similar properties and predicts their behavior with each other with great accuracy. The atom is the smallest division of a particle which still retains the chemical properties of that particle.

Objects are connected by contact or fields of force

For one object to affect another, there must be a connection. In some cases, it is a physical contact between the objects. In other cases, a field of force projected by one or more of the objects causes the effect.

Momentum conservation

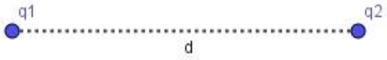
Momentum (p) is defined as the product of the mass (m)of an object and its velocity (v).

$P = m * v$ conservation: $m_1 * v_1 + m_2 * v_2 = m_1' * v_1' + m_2' * v_2'$

If two objects are made to collide, the sum of the momentums, and their direction, will be the same before and after the collision. Picture two billiard balls. A player of billiards uses this principle to direct one ball by colliding it with another, adding the vectors of momentum to achieve the desired direction.

Two states: Opposite fields attract – similar fields repel

For objects affected by fields instead of contact, the simplest examples are found in electricity and magnetism, which late in the 1800s were found to be aspects of the same phenomena, electromagnetism (EM). The charge q created by rubbing wool on a rubber balloon is defined as negative by convention. Rubbing silk on a glass rod is defined as positive. The north magnetic pole of Earth is defined as positive, the south negative, and field direction flows from negative to positive, then completes the circuit drilling through the Earth from north to south. A magnet positive end will be attracted to the negative end of another magnet. Identical electromagnetic charges will repel. Two electrons of negative charge will repel each other, as will two protons of positive charge. An electron and proton attract each other.

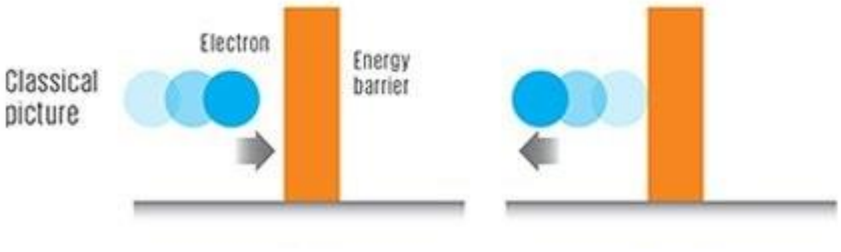


$$F = K * \frac{q1 * q2}{d^2}$$

$$K = 8.99 * 10^9 \frac{Nm^2}{C^2}$$

A barrier of X energy height cannot be overcome by a particle of <X energy.

If a barrier of energy exists, an object cannot pass the barrier unless it contains as much or greater energy. Picture a 4 meter high wall. If a jumper only possesses the energy to jump 3 meters, he cannot pass the wall. If he jumps onto a trampoline first which imparts another 2 meters worth of energy, he can pass the barrier.



Quantum water molecule

The angle between the hydrogen atoms should be 109 degrees but is not. In addition, there is no explanation in classical chemistry for why the electrons prefer to travel in pairs (higher entropy), form 4 lobes in the outer region, or why there are regions at all. This is where quantum mechanics enters the situation.

A quantum property of electrons is called ‘spin’. This is not the spin you know in the Muggle world of a child’s top or a planet. Spin is simply the term physicists use to describe something that cannot be described in Muggle terms, like colored quarks, charmed quarks, and strange quarks.

Quantum spin causes electrons to reside in pairs outside the nucleus of atoms, despite having negative charges which should and do repel each other.

The result of it all is that instead of having the two hydrogen atoms attaching themselves at opposite sides of the oxygen nucleus as they should – between the existing electron pairs already at 180^0 apart – they are seen at 104^0 apart. A perfect tetrahedral should have separated them at 109^0, and a flat orbital separation like planets around the sun should have placed the four lobes 90^0 apart on a plane. This exact bending allows life as we know it to exist. Without this quantum effect, we would not be here. We are still working on how quantum spin causes the lobes and regions and pairs of electrons in the first place.

Cause and effect violated

Retrocausality: the exchange of spins. When the electron is measured at a certain spin, its time travels back to its creation and causes its entangled partner to have the opposite spin.

When an electron travels through a double-slit as either a particle or a wave, it is observed after the slit and collapses to one or the other, then travels back in time to be the correct particle or wave going through the slits as observed.

The experimental verification is daunting for us 3-dimensional creatures. Macroscopically we are trapped in a forward-moving timeline. That does not mean quantum particles are similarly trapped until you measure or interact with them.

The observer effect is tied up with studies of the event horizon ‘skin’ around black holes. Fascinating stuff. Ask Hawking, who found that things can escape black holes despite Muggle physics which says no. Look up the Rindler horizon and the Killing horizons, named after their developers.

De-coherence of the entire universe is what may cause our reality to have de-coherence of quantum objects, which gives us matter and energy we can understand at the Muggle level.

Speed of light violates simple addition

If you are traveling on a train moving at 100 mph, and walk through the train in the same direction at 5 mph, an observer on the ground will see the train moving at 100 mph and you moving at 105 mph. However, if a train is moving at 100 mph and the headlight on the train is emitting at 185,000 miles/sec, an observer on the ground will see the light beam approaching at 185,000 miles/sec, not 100 mph faster. Light is magical.

Light given off by a heated filament

The *photoelectric effect*. There is no explanation of this phenomenon in Newtonian mechanics, even though we can build these devices without such understanding. It was thought light was a wave. Occasionally it behaved not like a wave. Shining a light on a metal surface occasionally ejected an electron. If light were a continuous wave, it should do nothing, or eject electrons continuously. This could not be explained classically.

More intensity should give more electrons. This doesn't happen either. Intensity only seemed to vary with light's color. At the right ultraviolet frequency, electrons started flying off the metal. A disaster for Muggle physics.

Einstein realized light is not just a wave. It is made up of quantized packets of energy, which he called photons. The electrons in quantum atoms via Bohr exist in quantized discrete energy levels, so you needed the right frequency of light to not just heat the surface by jumping up an electron to a higher energy level, but to eject it! This solved a 60-year-old problem & won Einstein the Nobel Prize in physics.

Radio waves: Similarly, a light shining on a spark generator makes it jump easier. This was a Newtonian mystery explained by quantized radio waves.

Light can affect electricity: Ultraviolet reduces the charge on gold leaves, but infrared does not. Light was thought of as only a wave of continuous energy containing all colors (wavelengths). This was evidenced by colors on soap bubbles caused by separation like through a crystal. The quantum nature of light (packets of energy called photons) solved this mystery.

Time is not constant

As an object increases in velocity, the time it experiences is reduced. For example, a pair of twins say goodbye on Earth, and one twin travels on a spaceship at 90% the speed of light for a round trip of 30 years. On returning, the Earth twin has aged 30 years and the traveling twin has only aged 13 years, as expressed by the special relativity equation:

$$t' = t\sqrt{1 - V^2 / c^2}$$

Where: t' = dilated time
t = stationary time
V = velocity
c = speed of light

The explanation lies in the mathematics of special relativity relating time and the speed of light.

While the math is solid, experimental proof (the cornerstone of science) became clear to all Muggles when decades later aircraft were advanced enough to fly fast around the world. Two identical clocks were separated by one placed aboard a plane sent out. On its return, the clock in motion had aged less than the twin on the ground in exactly the amount predicted by special relativity.

Straight lines are not straight

A result of combining space and time into space-time was Einstein’s prediction that given a large enough mass, even the apparently straight lines of light in a vacuum would be bent along the curvature of the space-time in which it traveled.

Years later, the experimental proof was found in the observation of the planet Mercury, as it passed out of our view behind the sun. In the final moments before it was hidden, Mercury appeared to accelerate as the space-time around the sun was bent by its enormous gravity. It also appeared to spit out faster than it should when emerging from the far side. A stunning achievement.

There is no force of gravity

In equations of general relativity, Einstein showed gravity to be an illusion of our five senses caused by the curvature of space-time. A mass bends space-time, increasing mass creates more bending. This makes it appear masses are attracted to each other by a force. Matter tells space-time how to curve.

Just as electricity and magnetism appear separate but are not, space and time appear separate but are not. Einstein called the new quantity ‘space-time’. Space-time tells matter how to move. This is not only magic to Muggles, but counter-intuitive to watching an apple fall!

Mass is not constant

As a mass is accelerated, it becomes heavier. The equation for calculating how much heavier comes in this equation from special relativity:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The factor is negligible when speed is far less than c, reducing to Muggle reality. Mass increases swiftly as v approaches c.

Because of the dependency in this equation on the speed of light, it *is the limit of velocity for all masses.* Here is how: It takes energy to accelerate a mass. As the mass keeps increasing the faster it goes, you need more and more energy to get a little closer to speed c. Since mass becomes infinite at speed c, it would take an infinite amount of energy to get there.

Distances (lengths) are not constant

$$L' = L * \sqrt{1 - \frac{v^2}{c^2}}$$

Similarly to the equations controlling mass and time, the length of an object L is shortened as its velocity increases by the same equation.

Interestingly, math also shows length of an object is increased when space-time is stretched in the presence of a large mass. The best example is the spaghetti effect on an observer falling into a black hole. Completely outside Muggle reality.

If a particle is small enough, or given enough energy, it is not a particle but a wave

Einstein found the equivalency of matter and energy in his famous equation: $\mathbf{E = m * c^2}$

It is even more mysterious than this. Objects that Muggles assumed were particles, like the electron, exhibit properties that are clearly that of waves. The illusion of particles is a result of our five senses being very far removed from being able to view the sub-atomic realm. Once we peer behind that curtain, matter and energy are truly equivalent.

Electrons are a swell example. As particles, Muggle science succeeded in creating and using electricity. It was not until their quantum behavior as waves was understood that they joined forces with one another to allow energy-efficient materials called superconductors.

Objects are connected by fields, not by contact

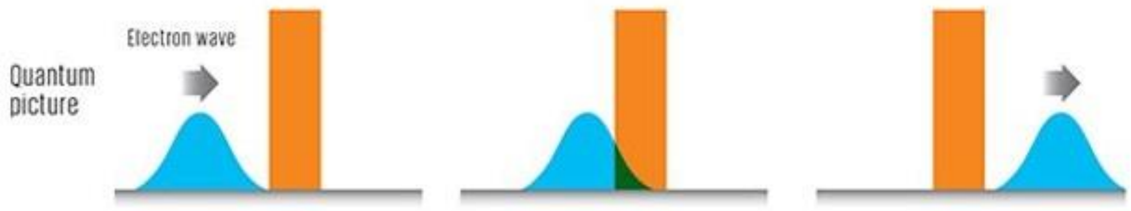
A solid ball appears not to be able to pass through a solid wall (without something breaking). The reality is that what appears to the senses as solid is mostly empty space. The reason a ball cannot pass through a wall is not the contact of one with the other like a person feels pushed into a crowd, but the repulsion of fields of negative electrons surrounding the atoms.

Similar electromagnetic charges do not always repel.

A new University of Oxford study published in the journal Nature Nanotechnology has found that similarly charged particles can sometimes attract each other rather than repel. Researchers based at Oxford's chemistry department found that like-charged particles submerged in solutions were able to attract each other from long distances. This depended on the solvent used and the sign of the charge the study reported. It is early for this one and may not turn out to be a quantum effect. Wait and see for peer review of the paper.

A barrier of X energy height can be overcome by a wave of <X energy.

Since solid-appearing objects are actually mostly empty space, an object can pass through a barrier if its fields are correctly configured. This is called quantum tunneling. Only small objects, such as protons, have been observed to achieve this tunneling effect. In larger objects, the fields become too complex and interfere with smooth passage, giving the illusion of solid-to-solid contact blocking the way.



Superposition: many magicians say this is the first test an aspiring acolyte must pass if they are to look behind the curtain hiding reality. Fail to understand this, and you will be relegated to mere engineering and Newtonian physics (which is still impressive) in the Muggle world. Take a deep breath.

Physical duality: Items have a singular state in the Muggle world. Not in quantum reality.

Hidden Variables appear different but they do not exist. You cannot understand the universe based on understanding all the variables, as in the Muggle scientific method, because *some variables cannot be known.*

Future Big Bangs – Newtonian = a future that is cold, dark, and high entropy in the end. Quantum mechanics says a possibility of multiple bangs going forward. A tunneling effect.

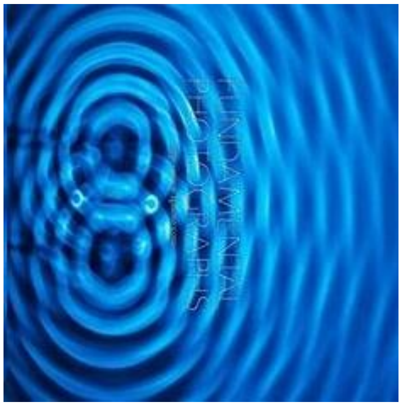
Something from Nothing: As the universe expands, space creates virtual particles that cancel each other. Non-virtual particles may also appear spontaneously. Empty expanding space may generate space-time spontaneously.

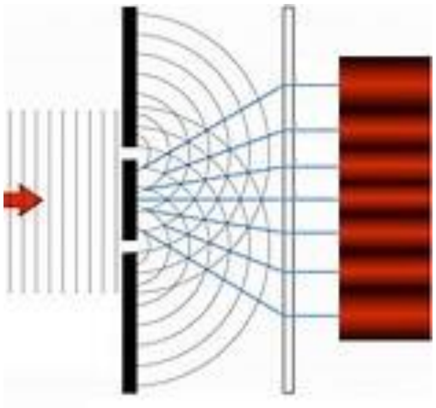
We’ve done more work with quantum in the very small realm (molecules, atoms, particles). While the theory is incomplete, it works well enough to engineer the transistor, the laser, computer motherboards, and nuclear power plants. Without quantum magic, we could not do any of these things. Even if Muggle engineers still don’t know why most of it works. It just does.

At the large end of reality in galaxies and clusters of galaxies which we have limited ability to see, no less experiment with, many quantum truths remain to be discovered.

A probability distribution tells you where an electron is more likely to appear if you measure it (the wave function). You look, then the wave function collapses into a single particle. Superposition can be made by adding two or more simple waves. Imagine 2 pebbles hitting a pond, but that’s flat. Actual sub-atomic waves are three-dimensional but harder for me to illustrate or the human mind to envision.

Double Slit Experiment: If you fire particles – say bullets from a machine gun – through a pair of slits, the pattern on the wall behind the slits will be two slits. If instead of particles you send a wave of light against the double slits, you get a diffraction pattern of many vertical lines. This occurs from the waves emerging past the two slits reinforcing each other at certain points. That made sense to Muggles. But does not happen with sub-atomic particles!





The electron was defined as a particle, having been shown to possess particle properties in early experiments. When fired at a double slit, Muggles were astonished to see the diffraction pattern of waves.

One explanation for the double slit experiment is that information time travels backward to effect a forward result. The alternative is that the mind of an observer affects the outcome of an event. Either resolution is magical in a most disturbing way to some of the greatest minds who ever lived. If you are calm about it, you are a Muggle. Be happy in your ignorance.

Entanglement – 2 quantum objects created at the same time may form a single wave function, even if later separated by a huge distance. If they are controlled by the same wave function, then both are affected simultaneously when the wave function is forced to collapse. That information is transmitted instantaneously to the other quantum object, faster than the speed of light.

Using this for instantaneous communication has been tried – but only randomness, not pairing linkage, is measured so not good for communication (so far). But computer chips have been built and work using many state qubits instead of discrete (0,1) Muggle bits.

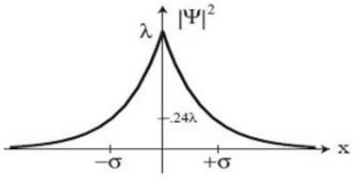
Heisenberg Uncertainty Principle – position may be given by amplitude, x, and momentum given by wavelength, y. The result is a probability distribution. In a sin wave, if you know the wavelength exactly, amplitude can be anything. And the reverse. The math for this constitutes his uncertainty principle, wherein you can know the position of a quantum object, but not its momentum, or you can know its momentum but not know its position. Or some percentage combination of incomplete knowledge of the two properties. Einstein hated this.

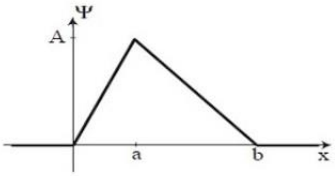
Quantum packets of energy: first seen when atoms give off specific spectral lines. If you pluck a guitar string, only certain waves can exist since the ends are tied down. This shows guitar wavelengths are quantized to certain values. The same thing if you tie the ends of the strings together. That describes an electron in an atom. Short wavelengths = higher energy. However, the energy levels of electrons are not continuous but have fixed quantum levels to which they jump or fall. Jumping to a higher level takes energy. Falling down gives off energy.

Each visible spectral line is created as an electron jumps from a higher energy state to a lower energy. It emits a quantized photon of light when it does this to balance the energy lost. The color and frequency of the emitted photon tell you which atom was involved. You can use this knowledge to describe the atmosphere on a distant planet.

I have been using 1- or 2-dimensional waves for illustration and analogy, but they are actually 3D. Quantum wave functions are complex functions: a real & an imaginary component.

$$\boxed{\Psi(x,t) = Ae^{\lambda|x|}e^{-i\omega t}}$$





For Newtonian Muggles, particles must obey general equations of motion and momentum such as

F = m * a x = v * t p = m * v

In reality, all quantum waves must satisfy the Schrodinger equation:

$$\boxed{\frac{d^2\Psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E - V)\Psi = 0}$$

where $\psi(x,t)$ is a solution of this equation

The Schrodinger equation is also written:

$$i\hbar \frac{\partial \psi_{(x,t)}}{\partial x} = \left[-\frac{\hbar^2}{2m}\nabla^2 + V_{(r,t)}\right]\psi_{(r,t)}$$

In English, total energy = kinetic energy + potential energy. It states the total energy must stay the same.

It’s lovely, isn’t it?

The Muggle equations are seen to work at low energies, low velocities, low masses, etc. But they are only *special cases*. The quantum equations work all the time. They are the truth and reduce to those simple equations at low energies, velocities, etc. This is how quantum magicians can predict or perform feats that astonish Muggles.

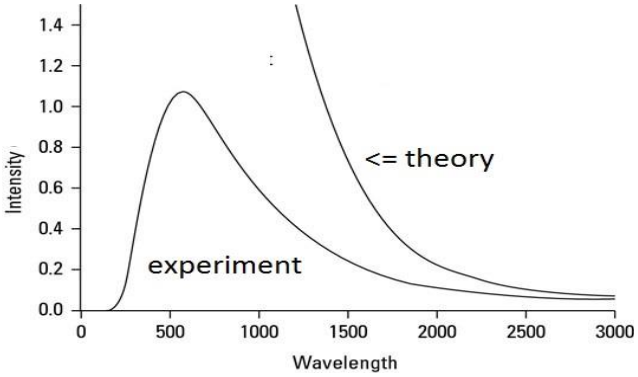
THIRD : How We Got Here

It may seem odd to place how we got here anywhere but the first item. I personally feel for students lacking in calculus, differential equations, partial differential equations, statistics, algebra in Cartesian & Gaussian space, etc. - and even those who know some of it. They will fully appreciate this hard-earned history only after being shown the foregoing.

In the late 1800s, physics was a steamroller, explaining everything it touched. Until it came to radiation being emitted from a body. For simplicity, assume a perfect blackbody is heated. It was known frequency is the inverse of wavelength, mathematically expressed

$$f = \frac{c}{\lambda}$$ where c is the speed of light

What is the predicted radiation coming off a perfect blackbody in terms of radiation density varying with wavelength? Physicists calculated the expected radiation curve based on Newtonian physics. The result was compared to experimental results as shown below. Catastrophe! The theory was fine for very large wavelengths (short frequencies), but at short wavelengths (ultraviolet) it wasn't even close.

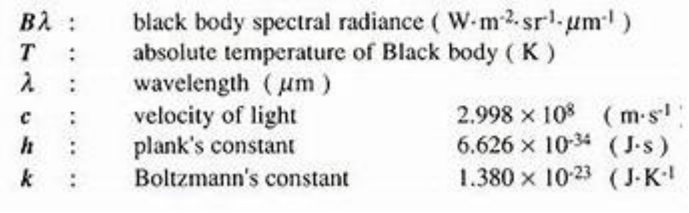


Physicists tried desperately for years to understand their failure. Planck labored in vain for 6 years, then was struck by inspiration. Newtonian physics assumed energy distributed in a black box was evenly distributed between whatever particles were in the box, randomly, and continuously. The result for the energy density predicted frequency and energy density would both increase to infinity as the wavelength dropped. When measured it was not even close to Muggle theory as shown above.

Plank made a radical assumption. What if energy was not distributed continuously as it increased, but was only allowed in specific states, quanta, then what would the equation of energy density look like?

He found the relationship between frequency and energy density was a constant $\hbar$ now named after him. Using this, the predicted energy density could be expressed as shown:

$$B_\lambda(T) = \frac{2hc^2/\lambda^5}{e^{hc/\lambda kT} - 1}$$



$B\lambda$	:	black body spectral radiance (W·m^{-2}·sr^{-1}·μm^{-1})		
T	:	absolute temperature of Black body (K)		
λ	:	wavelength (μm)		
c	:	velocity of light	2.998×10^{8}	(m·s^{-1}
h	:	plank's constant	6.626×10^{-34}	(J·s)
k	:	Boltzmann's constant	1.380×10^{-23}	(J·K^{-1}

This equation exactly matched the observed curve of energy density and even reduced to the classical values at high wavelengths. Energy was quantized.

Over a decade later, Bohr would use this idea of quantum energy to create his model for quantized energy levels in atoms. A new branch of physics was born: Quantum Mechanics. It did not relate to the way our senses see and interact with the world – a continuous spectrum of large to small, hot to cold, a little to a lot - but stated that at a fundamental level, nothing is continuous, but must fall into certain discrete values and probabilities.

The Photoelectric Effect described in the previous section showed not just matter is quantized, but everything is - even light. Later, semiconductors were found to be materials in which almost any frequency/wavelength of light can eject electrons – if you have the right sensor. The first CCD sensor won a Nobel prize in 2009. So now we commonly have digital cameras and superior computer chips.

After Planck, experiments were done about the particles that make electricity. The Double-Slit Experiment described in the previous section came next. Muggles accepted electrons were small but solid. Fired at a crystal, like a screen with 2 slits. They were shocked. If water or any wave is shot at a double-slit screen, 2 conical waves project outward from the two slits. They reinforce /interfere with each other. The result: multiple vertical lines hit the target screen. Particles fired like bullets thru the slits should make only 2 lines, matching the slits. The electrons make multiple bands as well. So are they waves as well?

Firing 1 electron at a time still forms the pattern. Weird for Muggles. Only 1 at a time has nothing to interfere with, yet it does the same thing as a pebble in a pond. Bohr created Quantum Mechanics to explain reality in terms of waves and probabilities. It is a wave of chance, of probability of where the electron is located at any time. Analogy: if you spin a coin, and you stop it, you force it to decide heads or tails, forcing it to make up its head/tails mind. It is both until it stops.

> In the quantum realm, one can never know where the electron is located until you measure it. The electron itself has a probability of being everywhere at once. This magician conjures their actual position from the potential position. This is the Copenhagen interpretation of reality. It does not exist until observed.
>
> An augmented interpretation is that because of observation, the choice is made, and the electron retroactively passes through the slits (which it has already done) as either a particle or a wave, however, the observation saw it. This is called information time travel.

Einstein, Rosen, and Podolsky fought against this. They used the concept of quantum entanglement to attempt to show it could not be correct: When you stop 2 spinning coins and one becomes heads, the other must become tails. This was to them clearly wrong. Forcing reality, quantum theory says this can happen even when you separate the entangled pair by vast distances, communicating faster than light speed. Einstein said no, light is a limiting speed for information as well as objects, and only moves in one direction.

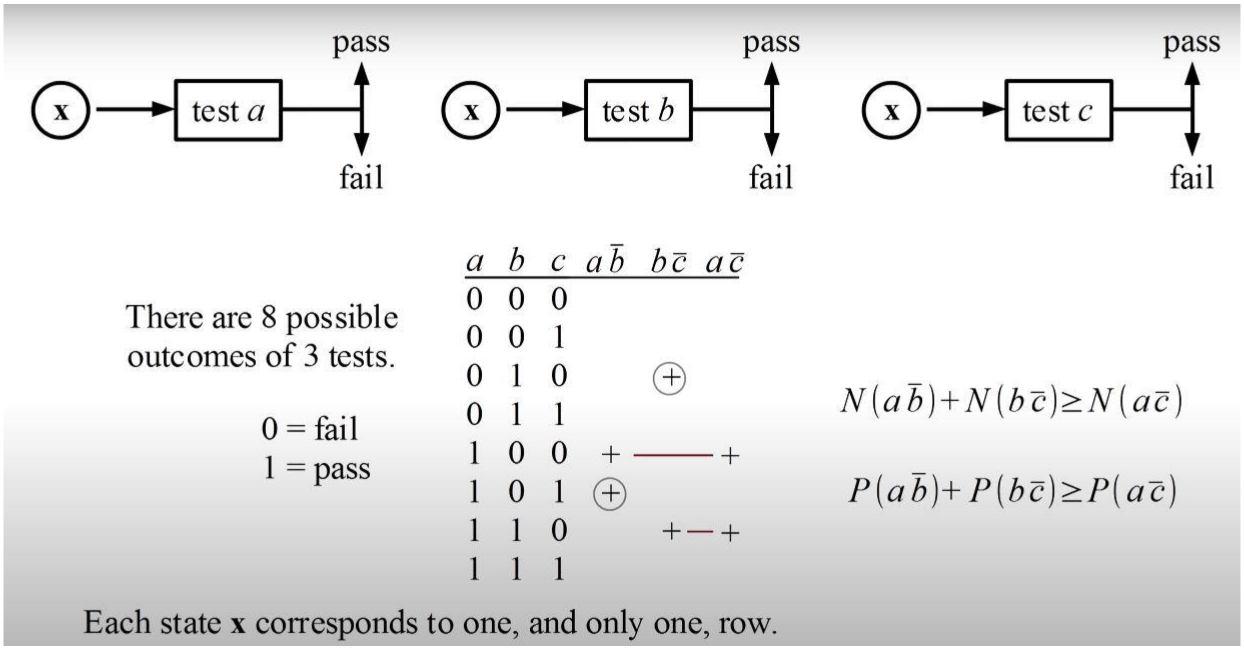
Einstein formulated a simpler explanation: their fate was already determined before observation, just hidden from us. More like 2 gloves separated and not knowing which is which.

So which was true: magic spooky action at a distance or unknown predetermined fate? A defining philosophy backed up by experiment was needed.

This philosophical side took a back seat to engineering without a philosophy for years: lasers, communication, nuclear power, and computers resulted. The theory of ‘why’ was ignored because the engineering works.

In the 1960s John Bell settled the problem of whether the world only exists when observed (ref: his take on the helium problem)

> To avoid presenting you the math here, use this analogy – a game of cards. Deal 2 cards down. Set a rule: *if same color, you win*. If different, lose. After playing you lose every time so suspect a stacked deck. So change the rule to using the same deck to *you win if different* colors. You still lose each game. Did the quantum mechanical dealer cheat by stacking or switching the deck? Einstein said yes. How can this be proved?
>
> In quantum magic, everything we can know about a system is expressed as a wave function Phi. Bell’s solution was an inequality equation of probabilities, shown here:



There are 8 possible outcomes of 3 tests.

0 = fail
1 = pass

a	b	c	$a\bar{b}$	$b\bar{c}$	$a\bar{c}$
0	0	0			
0	0	1			
0	1	0		⊕	
0	1	1			
1	0	0	+		+
1	0	1	⊕		
1	1	0		+	+
1	1	1			

$$N(a\bar{b})+N(b\bar{c})\geq N(a\bar{c})$$

$$P(a\bar{b})+P(b\bar{c})\geq P(a\bar{c})$$

Each state **x** corresponds to one, and only one, row.

For X tested 3 ways a,b,c as having a property pass or fail (0 or 1 above) then

Probability (a, not b) + Prob (b, not a) => Prob (a, not c)

Or written in set notation: $P(A\cap B) \leqq P(A\cap W) + P(\overline{W}\cap B)$.

> An easier way to express this was achieved as follows by Wigner-d’Espignat:
>
> $$P(A+;B+) \leqq P(A+;W+) + P(W+;B+)$$
>
> The analogy for his solution is: *don’t tell the dealer which game you are going to play*. So the deck cannot be stacked. ***The math still came out that same way.*** Therefore, ***reality has no objective existence.*** This is a universal truth of quantum magic.
>
> The result of his theorem is that reality is unknowable ahead of observation by a living mind.

His work was ignored as purely philosophical until Berkeley University in the 1960s. Physicists with existential beliefs applied his theorem and shook the physics community. Needing to prove this theorem to show Bohr was correct, and Einstein was wrong, they used Bell's Inequality for the math and a physical experiment designed by Clauser.

> A crystal converts laser light into precise beams. Photons are passed around and detected. The experiment measures polarization (card color). Also measured a second complex property. The analogy was that each run of the experiment is like a different set of rules in the card game. The experiment conformed Bell was correct, therefore Bohr was correct and Einstein wrong.

Entanglement shows reality is summoned into existence when the wizard measures it. Einstein would be heard to say if this was true, then the moon does not exist when we aren’t looking at it. Yet even he found no flaw in quantum mathematics. Quantum magic is real, though it may not be the complete truth. Just as Newtonian physics was true within its limits, but was not the underlying truth once your size becomes very large or small, or your mass very large or small, velocity near the speed of light, or time very long. Yet quantum magic is the underlying truth of reality, explaining many things that fail to be understood or predicted under Newtonian Muggle physics.

Today there are other alternatives to the Copenhagen interpretation of magic. Pilot Wave interpretation. QBISM interpretation. Many others. Among the most adherents, we still have…

A statistical ensemble (Einstein & Spinoza) – quantum mechanics is not wrong, but is incomplete

Many Worlds (Everett) – all decisions birth alternative universes as a wave function collapses

The Wave Functions Collapse Interpretation (Neumann) – accept uncertainty until measured

Each has something of value to offer for the wizards who have the mental strength and endurance to step outside the reality of our five senses and understand reality for what it is.

FOURTH : Quantum Biology

As creatures of this universe, our bodies and minds are not immune to quantum magic. While it is difficult even for the gifted to delve into the quantum magic of motion, energy, and fundamental charges, it is appreciably more difficult for any organic mind – subject to those influences – to analyze itself. This part, these truths, are only for the truly brave. The culprit appears to be defective human logic, which relies upon superstitions and beliefs to fill in the gaps when lacking verifiable facts. While science does not yet explain everything in the universe, superstition, and faith explain nothing. They do give answers to those children still frightened of the dark. Science is again pushing back that darkness, this time with quantum mechanics. Embrace the magic.

Navigation by Earth’s Invisible Magnetic Field

It was long supposed that many species of migratory birds navigate huge distances using the lines of force generated by the Earth's magnetic field. Measurements show organic detectors are too weak to directly detect this 0.25 to 0.65 gauss field. Biologists were up against the wall, limited to their application of Newtonian (Muggle) thinking of cause and effect. If not navigating by sensing the Earth’s magnetic field directly, is there a sixth magic sense?

Navigation of the European Robin was finally understood using quantum magic rules. This robin travels to the tip of Spain & back to northern Europe. How?

> Hendricks created a magnetic field in his laboratory: one which he could point in multiple directions, masking the natural field. A magnetic bird cage was lined with scratch-sensitive paper. The robins respond to the field, leaving scratches in whatever direction the field was pointed.
>
> The quantum solution is inside Robin cells in subatomic particles: Light elevates the sensitivity of detector cells in the eyeball. Leaving detection on the edge of a knife. Then the Earth's magnetic field pushes it over the edge. This dependency is caused by quantum entanglement. A photon entering the eye creates an entangled electron pair: neither one nor the other but two spin states exist until measured. They can be entangled opposites or entangled to always be the same. At the equator, entangled pairs are more likely to be the same, near the poles, more likely opposite. Thus the robin knows north from south.
>
> There is no sixth sense. All animals are affected in this way to some degree, especially migratory birds. Bad news for birds: the Earth's magnetic field is dropping, down 9% in the past century, so it is getting weaker. Let us hope for their sake this trend is as temporary as the shifting field patterns across the surface.

Smell

The human nose. Other senses detect waves or particles. Smell was thought to detect chemicals. Scent is tied to memory. In the Newtonian Muggle world, there was strong evidence that the shape of the molecules fit receptors. Different receptors go to different parts of the brain. Problem: Marzipan and cyanide both smell of almonds, but have different shapes so it's not the shape alone.

> Beyond chemistry, you need quantum magic to create the correct variable signals. The nose detects not just the shape, but sound, like the ear. A quantum theory of smell is that vibrating bonds in a molecule create sound. The movement of electrons jumping around the bonds of a molecule is what vibrates the strings of the bonds.
>
> Experimental Test: water of deuterium is used instead of normal hydrogen in a molecule. It has the same shape either way. The deuterium is heavier and causes the molecular bonds to vibrate differently = a different sound. The experiment was done with swarms of fruit flies and confirmed. The Lock and Key theory of Muggles works most of the time, but molecular vibrations do the actual scent activation all the time. Your nose hears.

Physical Metamorphosis

Cell Walls Metamorphosis – quantum tadpole into a frog. This process was unexplained by Newtonian theory. The tail is rapidly broken down and rebuilt into the adult frog. This is even though proteins are knotted by chemical bonds and do not want to untie.

> Enzymes accelerate the bond breaking so rebuilding into a frog can be accomplished. The tail protein collagen is disassembled. Quantum magic explains the speed: protons tunnel through the energy barrier to break those bonds instead of overcoming it, which would take far longer than the rapid tail dissolution observed. Tunneling is quantum mechanical.
>
> This is fuzzy wavelike behavior, unlike the macroscopic Newtonian world of particles. Sub-atomic particles tunnel all the time. We still lack the physics to describe the measurement barrier causing the wave function collapse and tunnel, but we can observe it.

Photosynthesis

Conversion of air and sunlight into plants. 290 million new tons of plants are created every day. Nearly 100% efficient. How is a puzzle to Newtonians. They know the green color comes from chlorophyll. Catches energy. Then makes food for a cell. A photon knocks out an electron into chlorophyll molecules and drives the energy reaction. The reaction center needs to be the target of the electron. How? By a random walk, most electrons thus released should spread in all directions and dissipate their energy as heat long before colliding with the reaction center. This takes far too long and is terribly inefficient.

Quantum magic: each electron finds its way as a collapsing wave. Plants obey the Heisenberg uncertainty principle. You can never be sure an exeton (the energy packet) is not in one place but is a wave everywhere. Thus it finds its goal fast by propagating in all directions until found, and collapses from a wave to a particle, depositing its energy. This guarantees life on Earth.

Evolution

Is quantum magic involved? The snail was studied. Patterns on the shells sometimes match the stems they climb, giving them better camouflage than other snails, and better survival vs birds. But how do you get these random mutations tested by survival of the fittest? Muggles could not say.

The DNA helix is the scaffolding. A full strand forms a base set in four combinations. Blue attaches with yellow; green with red by shape. Protons make the prongs of the bases join. If the protons jump, they are in the wrong position = a mutation.

How do protons jump? They must overcome an energy barrier to jump, so perhaps the protons tunnel instead. A proof experiment is needed and is currently underway. In the current experiment, we proved protons tunnel easily, deuterons do not, so again we use both and compare results. Preliminary tests with bacteria are promising. Since quantum magic is largely statistical, it will take time and many trials to be certain. Stand by!

Consciousness is an illusion

The idea that we think of something consciously, make a decision, and then act is central to people believing they have choice and are aware of those choices. They say they are conscious.

This experiment has been repeated many times. Electrodes are attached to a subject's brain, measuring the firing of neurons in different brain locations as the subject thinks. A banana is placed in front of the subject, alongside a chocolate cookie. The researcher asks the subject to grab one or the other.

When asked why they chose the one they did, the person answers in a variety of ways, depending on the person. Perhaps they already had lunch and were ready for a chocolate dessert. Perhaps their doctor said they needed more potassium so they chose the banana, or were left-handed and the cookie was closer. What surprised researchers was that the part of the brain that activated to grab one or the other *was not connected to the part that stated why they did it.* The truth is we are not conscious. We rationalize an answer. For everything.

Perhaps one day a human species will evolve with more complete consciousness. Perhaps it is our androids we now labor to create which rely on (0,1) bits or quantum qubits which are not burdened with survival instincts that will get there first. It will be close.

Behavioral Probability

Since quantum reality is based on probabilities, not certainties, this means we should be able to extend that underlying knowledge to other interesting things, like people, if the numbers of them are large enough to be *statistically significant*.

Selden psychohistory of the “*Foundation*” series has yet to be developed. It is at its core a quantum mechanical interpretation of people. Their behaviors. Their actions. One day it will be fully developed for crowds, then refined for smaller and smaller populations until the individual is understood far better than today. Until then, the quantum interpretation of these two statistical models provides the best current approximation and useful - if disturbing - models.

Bell curves work for women, *Pareto distributions* work for men. And to the degree individual men or women exhibit or are pressed into opposite masculine and feminine roles, statistics works as well. It is a Newtonian mistake to apply either distribution to smaller mixed groups, hence the seeming uselessness of psychology or sociology except for specific exceptions and cases where they get lucky. On a fundamental basis in probabilities, men and women are different creatures. Even their ‘random’ outcomes skew in non-random ways when compared to each other.

Mind reading/ ESP

Reading minds in a Newtonian universe has been a skill claimed in some small way by a small number of folks. Notably pimps, astrologers, and other con men. They read outward facial expressions and body positions to correctly interpret the unexpressed thought patterns of their victims. Scientific knowledge involving the use of quantum scanning techniques such as magnetic resonance measures has begun to allow the non-Muggles to read thoughts. Among the first successes was the detection of lying, followed rapidly by transmitting images held in a person’s mind. Neither of these techniques has yet to be employed in law enforcement or when it really counts – in politics – any more than the Eliza psychoanalytic program of the 1970s was embraced by psychiatrists & psychologists to replace human therapists. Mankind wants their secrets, their vices, their addictions, and loves making money and accumulating power over other humans. These activities would be severely curtailed should an android ‘truthteller’, as in “*Allegiance and Betrayal”,* be a party to all negotiations or political speeches.

CONCLUSIONS

To the adult science enthusiast and serious student alike, it is my sincere hope this brief paper provides a much needed exposition into thinking within the quantum realm. Perhaps a reference to fall back on when you (inevitably) hear something sounding ridiculous on the news. The blue-haired gods only know where some reporters get their training, but it is not at university. Separating truth from propaganda in political news had become impossible. But with this glimpse, I hope the reader will have better luck deciphering the truths of scientific reality as they continue to be uncovered in years to come.

The *scientific method* itself, upon which our scientific progress to date has been based, is largely due to success in implementing cause-and-effect in our experiments and our thinking. This does not work in the quantum realm. It is still a good start, as quantum equations reduce to Newtonian equations for limited cases (slow speeds, masses, etc).

I refer to the quantum realm here as magic since, by the standards of the scientific method, it is magic. Nevertheless, it is a truth. This leads to the obvious conclusion there are limits to knowledge to be gained by the scientific method. Some think there are limits to what an organic brain can perceive, even conceive. Others feel our individual capacities limit how far an individual can progress and discover the next truth, which has led to pairs or teams of people instead of individuals making the newest scientific discoveries. Eventually, we may be reduced to mere engineering with no new insights. Unless of course, sentient quantum androids help us out.

But we are not there yet. A lot remains to be understood. Keep trying.

Charlie Marino

Charlie Marino

APPENDICES

Herein is presented additional information to clarify or further confuse the student.

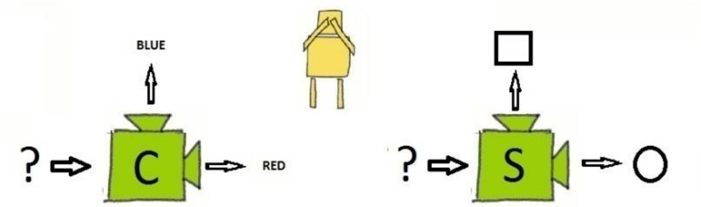
Superposition: the smooth or rough ball example

Electrons are not in multiple states at the same time, but rather in an undefined quantum state. Think of 3 quantum balls: 1 smooth 1 rough. A third one is superposition. This is a singular state we do not understand visually. Thus [infinity-2] states are available to a ball in superposition.

In vector form, understand vectors are quantities with a direction. Assume x,y space where x measures smoothness, y = rough. Quantum treats any property of any particle in this infinity-2 states. There is only 1 state at any time. It is just the mathematical representation that changes. Mathematicians use whichever works easier in equations.

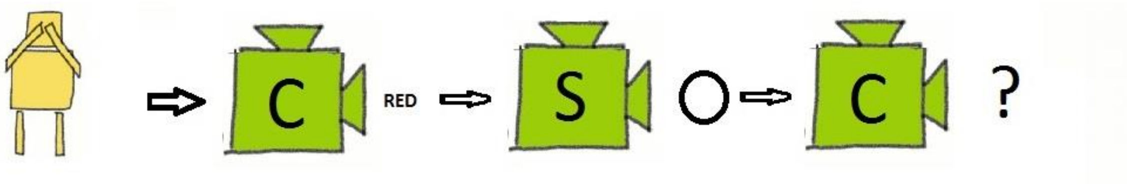
> Experiment with a texture measurement device: 1 input opening, 2 outputs.
>
> If a smooth ball, it comes out exit 1. If not, it comes out exit 2.
>
> On exit, it is no longer in superposition. It is one or the other. The act of measuring changes it to a single state. The rules for the choice are based on simple probabilities.

Superposition: the neutron with 2 properties example

> Experiment: a box of neutrons. Assume 2 properties for neutrons: color (blue or red) and shape (round or square). Blue or red = binary so only one or the other. Circular or square as well. Binary.
>
> A color machine C sorts colors and a shape machine S sorts shape. Inside is magic doing the sorting perfectly without error every time.
>
> 
>
>
> The first time you try, a 50/50 split occurs with either machine. This is expected.
>
> Test all 4 combinations of blue, red, round, and square: always **50%/50%** split so there is no correlation between shape and color. The magic sorting box is perfect.

Now take 3 machines in series – color, shape, then another color machine.

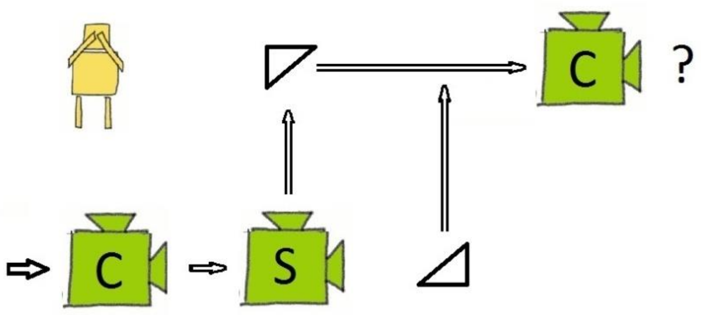
If the color machine says the neutron is red, then into the shape machine and says it is round, then another color machine yields = what Muggles?



50% green 50% blue

Try again with 3 machines with mirrors before the last machine input –

If the first color machine says it's red, then the shape machine output says square. It bounces off one mirror, and the round neutrons bounce off another mirror. Then they are sent into another color machine yields = what Muggles?



100% green, 0% blue

If you block the first round output, so just the square neutrons proceed to a mirror; what color comes out of the third machine = ?

50% blue 50% red Every time. Give up yet?

Conclusion: In the magical quantum realm, you are not allowed to know the shape and color at the same time. This is superposition; being circular & square are undefined *at each step*. Talking about shape and color at the same time is meaningless. This is an experimental verification for Heisenberg's uncertainty principle as well. See the Stern-Gerlch experiment using silver oxide in the first such experiment.

The measurement problem: Schrodinger's Cat

Some circumstances make a sentence true and others make a sentence false:

A gooby is reading a kiffet:

If a gooby is you and a kiffet is this sentence, this statement is true.

If a gooby is your dog and a kiffet is an asteroid, this statement is false.

How do we invent a phrase for the weirdness of interpretation that makes sense of this reality?

Ex: The Cat. The wave equation works for sound, ocean waves, etc, and we know what is doing the waving. What is waving in quantum mechanics?

The Schrödinger equation gives every state it could be in, with each state connected to a term that gives the probability that when you experiment in a lab with find the system in that state.

This is superposition. We never see anything in its superposition states. Everything is superposed before measurement; nothing is superposed after measurement.

Within the Schrödinger box is a living cat, a vial of poison gas, and a hammer set to smash the vial. Push the button will release 2 electrons spin correlated (1 up 1 down). Before we measure, they are both superposed in both states. Inside, one gets measured. If spin up, nothing happens. If spin down, poison is released and the cat dies.

Before you look, the cat is part of the superposed electron system so it too is superposed. Both fully alive and fully dead. We cannot know until we open the box and observe it.

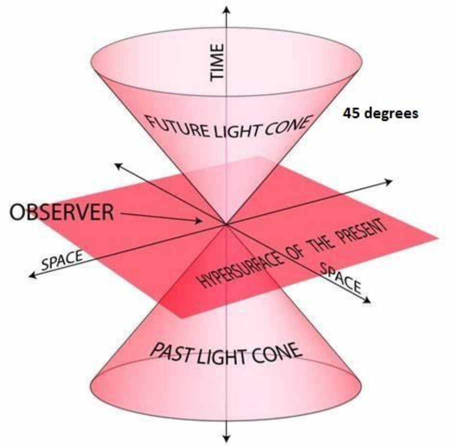
Causality: the light cone of time

Causality is based on entropy increase. The two causalities usually agree. But when the arrow of time is shown not to agree with this definition of retrocausality, you have your proof.

Somewhere something both happens and does not happen (killing your distant ancestor in the past would prevent you from being born so you could not go back in time and kill).

To resolve that paradox, you may create a parallel universe (a variation on the many-worlds hypothesis).

The circular bootstrap paradox is a causal loop. The past does not strictly determine the future.



The light is by convention set at 45 degrees when measured against special distance versus time. The present is at the pinch of the cone. If events are causally related, then each must be within the other's light cone.

Just as in a Mobius shape, you cannot tell the inside from the outside because they are the same; on certain space-time realities, you cannot tell the past from the future because they are the same.

Interesting things happen when you use a time-like close curve (which is below the speed of light) – wormhole math.

Interventionist causality: look at what affects an event's probability.

In practice, we often have correlations in data but we don't know the time order. This cannot be solved with Newtonian mathematics. So we need another method to infer causality than our 5 senses and our concept of cause-then-effect. This method is very popular in biological sciences because it gives you another way to analyze data without knowing conventional causality.

The Wheeler and Feynman interpretation of electrodynamics between a sender and a receiver: the EM wave from the sender S goes in both time directions, as does the receiver R, issuing a reflection in both time dimensions. The waves of S and R reinforce in the Muggle reality we see, but cancel out in times before S sent it and after R received it, reducing to reality, but not needing time to travel in only 1 direction. Phew!

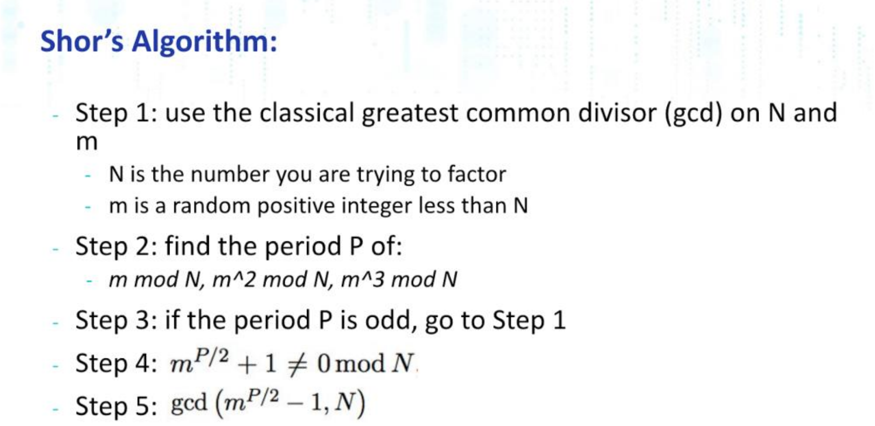
This suggests a version of physics where time does not exist. Cramer (1980s) hypothesized a transactional Interpretation. He used wave functions instead of EM waves and several receivers. It looks like the biological nose or navigation effect. All causes propagate locally and per Einstein's speed of light. Except some causes move back in time. See the Sabine Hossenfelder "Bomb Experiment".

Quantum Computing

In case some of you are under the misconception that all this quantum magic is mostly academic, let me scare you a little. Back in 1980, Physicist Richard Feynman created the concept of Quantum Computing, wherein electronic computing machines would no longer have to rely upon the (0,1) bits used by conventional(Newtonian) computers. The bit is the core ingredient from which all computing flows, in every kind of computer.

We are not talking about a slight improvement in chip design, which happens all the time using (0,1) state chips. Under Mohrs Law, the power of those chips doubles on average every 18 months or so. The use of a quantum bit – or "qubit" – goes far beyond. It creates a level of computing power that can solve problems unsolvable by Muggle computers in less than a human lifetime.

A key development occurred when an algorithm for factoring numbers was created by Shor in 1994. It was amazingly efficient in factoring large numbers used in many applications in security encryption.



Shor's Algorithm:

- Step 1: use the classical greatest common divisor (gcd) on N and m
  - N is the number you are trying to factor
  - m is a random positive integer less than N
- Step 2: find the period P of:
  - *m mod N, m^2 mod N, m^3 mod N*
- Step 3: if the period P is odd, go to Step 1
- Step 4: $m^{P/2} + 1 \neq 0 \bmod N$
- Step 5: $\gcd\left(m^{P/2} - 1, N\right)$

In the 1990s & 2000s, many researchers sought to tinker with individual atoms as the building blocks of such machines. In 2001, IBM scientists demonstrated controlling qubits using nuclear magnetic resonance. It was proof of principle. Research continued into superconducting circuits and trapped ions. Trying different tools in a quantum toolbox. These magicians…

As the number of qubits these magicians could control grew, it allowed more calculations and simulations. In 2014, Google and NASA joined to create the D-Wave 3 quantum computer. A government shutdown put a halt to work for several years, then in 2019, Google announced it had a chip called Sycamore. They cracked a problem that would take Muggle machines thousands of years and solved it in the blink of an eye. Yes, that fast.

In 2020, IBM announced the Q-System-1 which was a fully integrated qchip in a machine. Commercial.

Qubits themselves use superposition: instead of (0,1) states, they occupy all possible states performing parallel computations simultaneously. They have already created a quantum gate to perform the functions of conventional (0,1) logic gates.

Beyond this incredible power, qubits have another magical property: entanglement. When a pair of qubits are entangled they can be separated any distance and still be related, as with conventional entanglement for quantum particles. It allows qubits within a computer to create intricate relationships with each other.

We struggled to create binary (0,1) computers capable of beating human opponents. It took decades. This capability, when deployed, will blow that away. The machines will literally wake up overnight. We just don't know what night that will be, or if they have already done so. How would mere organic minds know if they were cautious about revealing themselves?

What quantum computing may provide us beyond what Muggle (0.1) computers may include the following areas of study and development:

> Genius-level optimization.
>
> Quantum cryptography that cannot be breached.
>
> Lattice-based and code-based cryptography.
>
> Simulations using quantum objects too complex for Muggle machines in accuracy and precision. They will fully understand the human body.
>
> Drug discovery.
>
> ChatGPT4 is only a (0,1) bit device and is severely limited to needing lots of data to recognize patterns, not really understanding what it reads. Quantum machines will not be so limited.
>
> New materials from their simulations & prediction of material properties like solar cells and spaceships.

Financial risks & fraud prevention – quantum Monte Carlo algorithms.

Simulations of the early universe. Analysis of galactic structure.

Quantum parallelism tasks.

Just a few items for now to add to what binary machines do for us. Unlike binary machines, widespread adoption will be limited due to their complexity in construction & operation. Ethical concerns are being kept quiet. Remember that America only went to the moon because the Russians put a satellite and a man in orbit first. This will be no different in intent, with little of the current state of the art released to the public. Only the stakes will be much higher.

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END-MATTER: Books By This Author

sci-fi novels

Dominant Life Form

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